SYSTEM AND METHOD FOR SERVICING NON-SCANNING PRINTHEAD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application Serial No. 60/317,114, filed on September 5, 2001 and incorporated herein by reference.

BACKGROUND

An inkjet printing system may include a printhead and an ink supply which supplies liquid ink to the printhead. The printhead ejects ink drops through a plurality of orifices or nozzles and toward a print medium, such as a sheet of paper, so as to print onto the print medium. Typically, the orifices are arranged in one or more arrays such that properly sequenced ejection of ink from the orifices causes characters or other images to be printed upon the print medium as the printhead and the print medium are moved relative to each other.

Use of the inkjet printing system may result in the accumulation of ink and particles, such as dust or paper fibers, on the printhead. To ensure quality print jobs, it is desirable that the accumulated ink and particles be removed from the printhead to prevent the accumulated ink and particles from dropping onto the print medium or obstructing the ejection of ink from the nozzles. In addition, during non-use of the inkjet printing system, the nozzles are exposed to air which, consequently, may cause the ink to dry out and clog the nozzles.

In order to ensure quality print jobs it would be desirable to service and maintain the printhead to avoid the aforementioned problems.

SUMMARY OF THE INVENTION

A system for servicing a non-scanning printhead includes a servicing plate, a servicing component mounted on the servicing plate and adapted to

service the non-scanning printhead, and a drive system adapted to move the servicing plate between a storage position and a service position such that the servicing component is spaced from the non-scanning printhead when the servicing plate is in the storage position and the servicing component is adapted to service the non-scanning printhead when the servicing plate is in the service position.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram illustrating one embodiment of an inkjet printing system including a system for servicing a non-scanning printhead.

Figure 2 is a schematic illustration of one embodiment of a portion of a continuous web print medium.

Figure 3 is a schematic side view illustrating one embodiment of a non-scanning inkjet printing system in a printing position with a servicing system in a storage position.

Figure 4 is a schematic side view illustrating one embodiment of the non-scanning inkjet printing system of Figure 3 in a servicing position.

Figure 5 is a schematic side view illustrating one embodiment of the non-scanning inkjet printing system of Figure 3 with the servicing system in a service position.

Figure 6 is a schematic side view illustrating one embodiment of the non-scanning inkjet printing system of Figure 3 with the servicing system in another service position.

Figure 7 is a schematic side view illustrating another embodiment of a non-scanning inkjet printing system in a servicing position.

Figure 8 is a schematic side view illustrating another embodiment of a non-scanning inkjet printing system in a servicing position with a servicing system in a storage position.

Figure 9 is a schematic side view illustrating one embodiment of the non-scanning inkjet printing system of Figure 8 with the servicing system in a service position.

Figure 10 is a schematic side view illustrating one embodiment of the non-scanning inkjet printing system of Figure 8 with the servicing system in another service position.

Figure 11 is a schematic bottom view illustrating another embodiment of a non-scanning inkjet printing system including a plurality of printheads and a plurality of service stations.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific embodiments in which embodiments of the invention may be practiced. In this regard, directional terminology such as "up," "down," "forward," "backward," "leading," "trailing," "above," "below," etc., is used with reference to the orientation of the figure(s) being described. Because components of the embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

Figure 1 illustrates one embodiment of an inkjet printing system 10 including a system for servicing a non-scanning printhead. Inkjet printing system 10 includes an inkjet printhead assembly 12, an ink supply assembly 14, a mounting assembly 16, a print media transport assembly 18, a service station assembly 20, and an electronic controller 22. In one embodiment, inkjet printhead assembly 12 includes one or more printheads 24 which eject drops of ink through a plurality of orifices or nozzles 13 and toward an embodiment of media, such as print medium 19, so as to print onto print medium 19. Print medium 19 includes any type of suitable sheet material, such as paper, cardstock, transparencies, Mylar, cloth, and the like. Typically, nozzles 13 are arranged in one or more columns or arrays such that properly sequenced ejection of ink from

nozzles 13 causes characters, symbols, and/or other graphics or images to be printed upon print medium 19 as inkjet printhead assembly 12 and print medium 19 are moved relative to each other.

Ink supply assembly 14 supplies ink to inkjet printhead assembly 12 and includes a reservoir 15 for storing ink. As such, ink flows from reservoir 15 to inkjet printhead assembly 12. In one embodiment, inkjet printhead assembly 12 and ink supply assembly 14 are housed together to form an inkjet cartridge or pen 26 (Figure 3). In another embodiment, ink supply assembly 14 is separate from inkjet printhead assembly 12 and supplies ink to inkjet printhead assembly 12 through an interface connection, such as a supply tube. In either embodiment, reservoir 15 of ink supply assembly 14 may be removed, replaced, and/or refilled.

Mounting assembly 16 supports inkjet printhead assembly 12 relative to print media transport assembly 18. Print media transport assembly 18 positions print medium 19 relative to inkjet printhead assembly 12. Thus, a print zone 17 is defined adjacent to nozzles 13 in an area between inkjet printhead assembly 12 and print medium 19. In one embodiment, inkjet printhead assembly 12 is a non-scanning or fixed printhead assembly. As such, mounting assembly 16 fixes inkjet printhead assembly 12 at a prescribed position relative to print media transport assembly 18. Thus, print media transport assembly 18 advances or positions print medium 19 relative to inkjet printhead assembly 12.

Service station assembly 20 includes at least one servicing component for wiping, capping, spitting, and/or priming of inkjet printhead assembly 12 in order to maintain functionality of inkjet printhead assembly 12 and, more specifically, nozzles 13, as will be further described below. Functions of service station assembly 20 rely on relative motion between service station assembly 20 and inkjet printhead assembly 12.

Electronic controller 22 communicates with inkjet printhead assembly 12, mounting assembly 16, print media transport assembly 18, and service station assembly 20. Electronic controller 22 receives data 23 from a host system, such as a computer, and includes memory for temporarily storing data 23. Typically, data 23 is sent to inkjet printing system 10 along an electronic, infrared, optical or other information transfer path. Data 23 represents, for

example, a document and/or file to be printed. As such, data 23 forms a print job for inkjet printing system 10 and includes one or more print job commands and/or command parameters.

In one embodiment, electronic controller 22 provides control of inkjet printhead assembly 12 including timing control for ejection of ink drops from nozzles 13. As such, electronic controller 22 defines a pattern of ejected ink drops which form characters, symbols, and/or other graphics or images on print medium 19. Timing control and, therefore, the pattern of ejected ink drops is determined by the print job commands and/or command parameters.

In one embodiment, as illustrated in Figure 2, print medium 19 is a continuous form or continuous web print medium 19. As such, print medium 19 may include a plurality of continuous print medium sections 30. Print medium sections 30 represent, for example, individual sheets, forms, labels, or the like which may be physically separated from each other by cutting or tearing along, for example, perforated lines 191. In addition, print medium 19 may include a continuous roll of unprinted paper with print medium sections 30 individually delineated by indicia, openings, or other markings. Since inkjet printhead assembly 12 is fixed, print medium 19 moves relative to inkjet printhead assembly 12 during printing. More specifically, print medium 19 is advanced relative to inkjet printhead assembly 12 in a direction indicated by arrow 32.

Figure 3 illustrates one embodiment of a portion inkjet printing system 10. Inkjet printing system 10 includes a printhead 24, a service station assembly 20, a platen 40, and a printhead mounting plate 50. Platen 40, as part of print media transport assembly 18, supports print medium 19 so that print medium 19 may be advanced relative to platen 40 in a direction perpendicular to a plane defined by Figure 3, as indicated by direction arrow 42. Printhead mounting plate 50, as part of mounting assembly 16, is positioned to support printhead 24 relative to platen 40 and print medium 19.

In one embodiment, printhead mounting plate 50 includes a printhead aperture 52 and a clearance aperture 54 (Figures 3 and 11). Printhead aperture 52 receives printhead 24 such that printhead 24 extends through printhead aperture 52 towards print medium 19. Clearance aperture 54 is sized and shaped to receive service station assembly 20 such that service station assembly 20 may

be selectively moved into and out of printhead mounting plate 50. Accordingly, service station assembly 20 is movably connected to printhead mounting plate 50, as will be further described below.

In one embodiment, as illustrated in Figure 3, service station assembly 20 includes a drive system 60, a servicing plate 62, and first and second servicing components 64 and 66, respectively. Drive system 60 effectuates movement of servicing plate 62 relative to printhead mounting plate 50 and, therefore, printhead 24, as described below, to service printhead 24. Servicing plate 62 supports servicing components 64 and 66 and includes a leading end 68 and a trailing end 70. Leading end 68 is located nearer printhead 24 than is trailing end 70. Servicing components 64 and 66 are each mounted on and move with servicing plate 62. Servicing components 64 and 66 and servicing plate 62 collectively form a service station 67. In one embodiment, servicing components 64 and 66 are mounted adjacent to and/or toward leading end 68 of servicing plate 62.

Servicing components 64 and 66 are positioned on servicing plate 62 such that each servicing component 64 and 66 interacts with or services printhead 24 when servicing plate 62 is in a corresponding service position. For example, servicing component 64 services printhead 24 when servicing plate 62 is in a first service position, and servicing component 66 services printhead 24 when servicing plate 62 is in a second service position. Notably, servicing plate 62 may support one servicing component or a number of servicing components, such as a wiper, a cap and a spring, and/or a spittoon, in a variety of different configurations and, therefore, may service printhead 24 from a variety of different service positions or combinations thereof.

In one embodiment, servicing component 64 may include a rubber blade or wiper 72. Wiper 72 is supported by servicing plate 62 and extends upwardly (with respect to the orientation of Figure 3) from servicing plate 62. As such, wiper 72 may be selectively passed across printhead 24 to scrape printhead 24 and remove any residual ink, collected fibrous material, or other debris that may collect on printhead 24.

In one embodiment, servicing component 66 may include a cap 74. Cap 74 is sized to cover a front face 25 of printhead 24 to seal and protect nozzles 13

(Figure 1) from drying out during periods of non-use. In one embodiment, servicing component 66 may include one or more springs 76 which bias cap 74 against printhead 24.

As described above, drive system 60 moves servicing plate 62 relative to printhead mounting plate 50 and, therefore, printhead 24. In one embodiment, drive system 60 is connected to servicing plate 62 near trailing end 70 opposite of servicing components 64 and 66 such that drive system 60 does not interfere with the interaction between servicing components 64 and 66 and printhead 24.

In one embodiment, as illustrated in Figure 3, drive system 60 includes a drive block 80, a drive element 82, a drive feature 84, and a drive actuator 86. Drive block 80 is connected to and extends between servicing plate 62 and drive element 82. Drive block 80 may be connected to servicing plate 62 directly or by a drive arm 88, which extends along or near trailing end 70 of servicing plate 62.

In one embodiment, drive feature 84 is associated with printhead mounting plate 50 and drive element 82 is connected to servicing plate 62. Drive element 82 interacts with drive feature 84 to move servicing plate 62 relative to printhead mounting plate 50. More particularly, drive element 82 and drive feature 84 interact to guide servicing plate 62 and, therefore, service station 67 between a storage position, as illustrated in Figure 3, and one or more service positions.

In the storage position, servicing plate 62 is positioned in clearance aperture 54 and recessed at least partially within printhead mounting plate 50. Thus, service station assembly 20 does not interfere with the spacing between printhead 24 and print medium 19 during the printing process. In the service positions, servicing plate 62 is displaced from clearance aperture 54 and positioned between printhead mounting plate 50 and platen 40 to facilitate servicing of printhead 24 with servicing components 64 and 66.

In one embodiment, drive actuator 86 is coupled with printhead mounting plate 50 and drive block 80 to move drive block 80 and, therefore, servicing plate 62 as drive element 82 interacts with drive feature 84. More specifically, drive actuator 86 is secured to printhead mounting plate 50 such that actuation of drive actuator 86 generates movement of drive block 80 relative to

printhead mounting plate 50. Alternatively, drive actuator 86 may be directly coupled with drive element 82, drive arm 88, or servicing plate 62, rather than drive block 80, to move servicing plate 62 relative to printhead 24. Drive actuator 86 may include a ballscrew, a leadscrew, an air cylinder, a hydraulic cylinder, or other actuation device.

In one embodiment, drive element 82 includes a cam follower 90 and drive feature 84 includes a cam slot 92. Cam follower 90 fits within and follows cam slot 92 to guide and move servicing plate 62 relative to printhead mounting plate 50. In one embodiment, cam slot 92 is formed in a sidewall of printhead mounting plate 50 and cam follower 90 includes a pin which fits into cam slot 92.

In one embodiment, cam slot 92 includes cam slot regions 94, 96, and 98. Cam slot regions 94, 96, and 98 define a single slot which forms cam surfaces which guide cam follower 90 and move servicing plate 62 between the storage position and the service positions. In one embodiment, cam slot region 94 is oriented at a non-parallel angle with respect to cam slot region 96 for moving servicing plate 62 from the storage position to a first service position. In addition, cam slot region 96 communicates with cam slot region 94 and extends between cam slot region 94 and cam slot region 98. Cam slot region 96 is oriented such that servicing plate 62 can move back and forth relative to printhead 24 to service printhead 24. Furthermore, cam slot region 98 communications with cam slot region 96 opposite of cam slot region 94 and is oriented at a non-parallel angle with respect to cam slot region 96 for moving servicing plate 62 to a second service position.

In one embodiment, cam slot region 94 is longer and extends further upwardly from cam slot region 96 than cam slot region 98. Thus, servicing plate 62 may be recessed within clearance aperture 54 of printhead mounting plate 50 when in the storage position. Notably, cam slot 92 may be formed in a number of configurations for supporting and guiding cam follower 90 and, consequently, servicing plate 62 in and between the storage position and one or more service positions.

In one embodiment, as illustrated in Figure 3, inkjet printing system 10 includes a lift actuator 100. Lift actuator 100 is coupled with printhead

mounting plate 50 to selectively move printhead mounting plate 50 towards and away from platen 40 and, therefore, position printhead 24 relative to print medium 19. While lift actuator 100 is illustrated as being coupled with printhead mounting plate 50 and platen 40, it is understood that lift actuator 100 may be coupled with printhead mounting plate 50 and other components of inkjet printing system 10 so as to provide relative positioning between printhead mounting plate 50 and platen 40.

In one embodiment, as illustrated in Figures 3 and 4, lift actuator 100 moves printhead mounting plate 50 between a printing position, as illustrated in Figure 3, and a servicing position, as illustrated in Figure 4. In the printing position, printhead mounting plate 50 is spaced a distance D1 from platen 40. In the servicing position, printhead mounting plate 50 is spaced a distance D2 from platen 40. Notably, when printhead mounting plate 50 is in the printing position, printhead 24 is positioned to print onto print medium 19. Conversely, when printhead mounting plate 50 is in the servicing position, printhead 24 is positioned to be serviced by service station assembly 20. Thus, distance D2 is greater than distance D1 to facilitate positioning of servicing plate 62 between printhead mounting plate 50 and platen 40 for servicing of printhead 24 with servicing components 64 and 66, as described below.

Figures 3-6 illustrate one embodiment of servicing printhead 24 with service station assembly 20. Figure 3 illustrates one embodiment of printhead mounting plate 50 when in the printing position and servicing plate 62 when in the storage position. Printhead mounting plate 50 remains in the printing position during a printing process. In one embodiment, when servicing plate 62 is in the storage position, servicing plate 62 is positioned in clearance aperture 54 of printhead mounting plate 50. As such, servicing plate 62 is recessed at least partially within printhead mounting plate 50 and is positioned so that servicing plate 62 is held above (with respect to the orientation of Figure 3) front face 25 of printhead 24. As such, service station assembly 20 does not interfere with the spacing between printhead 24 and print medium 19 during the printing process.

In one embodiment, as illustrated in Figure 4, to service printhead 24, lift actuator 100 effectuates movement of printhead mounting plate 50 to the

servicing position. As such, printhead 24 is spaced a distance D3 from platen 40so that space is created between printhead 24 and platen 40 to facilitate servicing of printhead 24.

Once printhead 24 is spaced from platen 40, as illustrated in Figure 4, drive actuator 86 is actuated to move drive system 60 so that servicing plate 62 moves relative to printhead mounting plate 50. In particular, the initial motion imparted by drive actuator 86 translates cam follower 90 along cam slot 92, namely along cam slot region 94 to cam slot region 96. Since cam follower 90 is connected to servicing plate 62 via, for example, drive block 80, movement of cam follower 90 along cam slot region 94 to cam slot region 96 induces movement of servicing plate 62 from the storage position, as illustrated in Figure 4, to a first service position, as illustrated in Figure 5.

In one embodiment, as illustrated in Figure 5, the first service position of servicing plate 62 enables wiper 72 to contact printhead 24. The first service position may include a plurality of positions in which cam follower 90 is supported by cam slot region 96 such that drive actuator 86 moves cam follower 90 along cam slot region 96 to selectively move wiper 72 in and out of contact with printhead 24. In one embodiment, drive actuator 86 may be selectively actuated in the directions indicated by double arrow 87 to move cam follower 90 along cam slot region 96 and selectively move wiper 72 back and forth across printhead 24. Notably, the substantially horizontal orientation of cam slot region 96 facilitates back and forth movement of servicing plate 62 while maintaining contact between wiper 72 and printhead 24.

As illustrated in Figure 6, subsequent actuation of drive actuator 86 moves servicing plate 62 to a second service position. More particularly, servicing plate 62 is moved to the second service position as cam follower 90 is driven along cam slot region 96 to cam slot region 98 so that servicing plate 62 moves up and under printhead 24 permitting cap 74 to mate with and cap printhead 24. In one embodiment, printhead aperture 52 is sized to receive wiper 72 so that cap 74 can effectively seal printhead 24 as servicing plate 62 moves up and under printhead 24.

Drive actuator 86 may also be actuated to impart return movement of servicing plate 62 from the second service position back to the first service

position and from the first service position back to the storage position. Otherwise stated, drive actuator 86 may be actuated to move cam follower 90 down cam slot region 98, across cam slot region 96, and up cam slot region 94, thereby, returning servicing plate 62 to the storage position. Furthermore, servicing plate 62 may move from the first service position back to the storage position without moving to the second service position.

Figure 7 illustrates another embodiment of an inkjet printing system. Inkjet printing system 10' includes printhead 24, service station assembly 20, platen 40, and printhead mounting plate 50, as described above. Inkjet printing system 10', however, includes a lift actuator 100'. Lift actuator 100' is coupled with printhead mounting plate 50 to move printhead mounting plate 50 relative to platen 40. Lift actuator 100' distances or spaces printhead 24 from platen 40 and print medium 19 by tilting printhead mounting plate 50 away from platen 40 to position printhead mounting plate 50 in a printhead servicing position. As such, servicing station assembly 20 may service printhead 24 in the manner described above. It is understood that lift actuator 100' may also lift and tilt printhead mounting plate 50 away from platen 40 to position printhead mounting plate 50 in the printhead servicing position.

As illustrated in the embodiment of Figures 3-7, drive feature 84 is associated with printhead mounting plate 50 and drive element 82 is connected to servicing plate 62. More specifically, cam slot 92 is formed in printhead mounting plate 50 and cam follower 90 is secured to drive block 80 which, in turn, is connected to servicing plate 62. As such, drive block 80, cam follower 90, and servicing plate 62 move as a unit. Thus, actuation of drive block 80 causes drive block 80 and, therefore, cam follower 90 to move within cam slot 92 relative to printhead mounting plate 50 to guide servicing plate 62 and, therefore, service station 67 between the storage position, as illustrated in Figures 3 and 4, and one or more service positions, as illustrated, for example, in Figures 5 and 6.

As illustrated in the embodiment of Figures 8-10, however, drive element 82 is connected to printhead mounting plate 50 and drive feature 84 is associated with servicing plate 62. More specifically, cam follower 90 is secured to printhead mounting plate 50 and cam slot 92 is formed in drive block 80 which,

in turn, is connected to servicing plate 62. As such, drive block 80, cam slot 92, and servicing plate 62 move as a unit. Thus, actuation of drive block 80 causes drive block 80 and, therefore, cam slot 92 to move along cam follower 90 relative to printhead mounting plate 50 to guide servicing plate 62 and, therefore, service station 67 between the storage position, as illustrated in Figure 8, and one or more service positions, as illustrated, for example, in Figures 9 and 10.

In one embodiment, as illustrated in Figure 11, inkjet printing system 10, as does inkjet printing system 10', includes a plurality of printheads 24 and a plurality of service stations 67 each including a respective servicing plate 62 and one or more servicing components 64 and/or 66. In this embodiment, printhead mounting plate 50 includes a plurality of printhead apertures 52 and a plurality of clearance apertures 54. Each printhead 24 is received by a corresponding printhead aperture 52 such that each printhead 24 protrudes from a respective printhead aperture 52 toward platen 40 and print medium 19 (Figures 3-10). Clearance apertures 54 are sized and shaped to allow service stations 67 to be selectively moved into and out of printhead mounting plate 50 between the storage position and one or more service positions, as described above.

In one embodiment, as illustrated in Figure 11, printheads 24 and, therefore, printhead apertures 52 are spaced apart and staggered such that each printhead 24 is aligned with and/or overlaps at least one adjacent printhead 24. In one embodiment, printheads 24 are arranged in a stair-step manner. In another embodiment, printheads 24 are arranged in a plurality of stair-step patterns.

Service stations 67 are arranged to correspond with the arrangement of printheads 24 such that each service station 67 can service a corresponding printhead 24. For example, as illustrated in Figure 11, a stair-step arrangement of printheads 24 results in a corresponding stair-step arrangement of service stations 67. In one embodiment, service stations 67 are each joined to drive arm 88 such that movement of drive arm 88 causes simultaneous movement of service stations 67.

Although specific embodiments have been illustrated and described herein for purposes of description of the preferred embodiment, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate

and/or equivalent implementations calculated to achieve the same purposes may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. Those with skill in the chemical, mechanical, electro-mechanical, electrical, and computer arts will readily appreciate that the present invention may be implemented in a very wide variety of embodiments. This application is intended to cover any adaptations or variations of the preferred embodiments discussed herein. Therefore, it is manifestly intended that this invention be limited only by the claims and the equivalents thereof.